

Kolby J. Jardine

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Professional Preparation

Colorado School of Mines (Chemistry) transferred to New York University (Biochemistry), B.S. 1999

South Dakota School of Mines and Technology (Atmospheric Chemistry), M.S., 2004

Stony Brook University (Atmospheric and Marine Sciences), Ph.D., 2008

University of Arizona and the National Center for Atmospheric Research (Biosphere-Atmosphere Interactions), Post-Doctoral fellow, 2008-2009

Appointments

- June 2012-present: Project Scientist, Green Ocean Amazon (GoAmazon) Terrestrial Ecosystem Project, Lawrence Berkeley National Laboratory (Berkeley, CA, USA) and Instituto Nacional de Pesquisas da Amazônia (Manaus, Brazil)
- April 2012-June 2012: Visiting Scientist, University of Bielefeld, Bielefeld, Germany
- July 2009–April 2012: Assistant Research Professor, Biosphere 2, University of Arizona, Tucson, AZ
- July 2010–Nov 2010: Visiting scholar, Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil
- July 2008–July 2009: Postdoctoral Research Fellow, National Center for Atmospheric Research, Boulder, CO and Biosphere 2, University of Arizona, Tucson, AZ
- Aug 2004–May 2008: Biosphere-Atmosphere Research and Training (BART) Doctoral Research Fellowship; University of Michigan Biological Station
- Jan 2003–May 2004: M.S. Student, South Dakota School of Mines and Technology, Rapid City, SD.
- Jan 2001–Dec 2002: Instructor, Chemistry I/II, Microbiology, Math for Electronics, and Algebra I, San Juan College, Farmington New Mexico
- Aug 1999–May 2000: Graduate student, NSF fellow in Optical Biomolecular Devices, Department of Chemistry and Biochemistry, Arizona State University, Tempe, AZ
- Jan 1997–May 1999: Undergraduate Research Assistant, DNA Nanotechnology, Department of Chemistry, New York University, New York City, NY
- Jan 1994–June 1996: Research Internship, Fruit Fly Molecular Genetics, Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA

Peer Reviewed Publications

1. **Jardine K**, Chambers J, Oikawa P, Fuentes J, Fernandez de Souza V, Garcia S, Concalves Jose, Manzi A, Higuchi N, Bill M, Porras R, Niinemets U (2015) Integration of C₁ and C_{2,3} metabolism in Trees, Plant Cell and Environment, *in review*.
2. Jardine A, **Jardine K**, Fuentes J, Martin S, Martins G, Durgante F, Carneiro V, Higuchi N, Manzi A, Chambers J (2015) Highly-reactive light-dependent monoterpenes in the Amazon Basin, *Geophysical Research Letters*, 42.
<http://dx.doi.org/10.1002/2014GL062573>
3. **Jardine K**, Yañez-Serrano A, Williams J, Kunert N, Jardine A, Taylor T, Abrell L, Artaxo P, Guenther A, Hewitt C.N., House E., Florentino A P, Manzi A, Kesselmeier J, Behrendt T, Veres P R, Derstroff B, Fuentes J, Martin S, Andreae M O (2015) Dimethyl Sulfide in the Amazon Forest, *Global Biogeochemical Cycles*, early view online.
<http://dx.doi.org/10.1002/2014GB004969>
4. Yañez-Serrano A, Nölscher A, Williams J, Wolff S, Alves E, Martins G, Bourtsoukidis E, Brito J, **Jardine K**, Artaxo P, and Kesselmeier J. (2014) Diel and seasonal changes of biogenic volatile

organic compounds within and above an Amazonian Rainforest site. *Atmospheric Chemistry and Physics Discussions*, 14, 29159-29208.

<http://dx.doi.org/10.5194/acpd-14-29159-2014>

5. **Jardine K**, Chambers J, Alves E, Tiexiera A, Garcia S, Holm J, Higuchi N, Manzi A, Abrell L, Fuentes J, Nielsen L, Torn M, Vickers C (2014). Dynamic balancing of isoprenoid intermediates reflect leaf photosynthetic and photorespiratory responses to temperature stress. *Plant Physiology*, 166: 1-14.
<http://dx.doi.org/10.1104/pp.114.247494>
6. Holm J, **Jardine K**, Guenther A, Chambers J, Tribuzy E (2014) Evaluation of MEGAN-CLM parameter sensitivity to predictions of isoprene emissions from an Amazonian rainforest. *Atmospheric Chemistry and Physics Discussions*, 14: 23995-24041.
<http://dx.doi.org/10.5194/acpd-14-23995-2014>
7. Niinemets U, Fares S, Harley P, **Jardine K** (2014) Bidirectional exchange of biogenic volatiles with vegetation. *Plant Cell and Environment*, 37(8): 1790-1809.
<http://dx.doi.org/10.1111/pce.12322>
8. Alves E., Harley P., Gonçalves F., & **Jardine K** (2014). Effects of temperature on isoprene emission of the tropical tree species *Eschweilera coriacea* during leaf phenology in the central Amazon. *Acta Amazonica*, 44(1): 9-18.
<http://dx.doi.org/10.1590/S0044-59672014000100002>
9. **Jardine K**, Wegener F, Abrell L, van Haren J, Werner C (2014) Phytogenic biosynthesis and emission of methyl acetate. *Plant Cell and Environment*, 37: 414-424.
<http://dx.doi.org/10.1111/pce.12164>
10. **Jardine J**, Meyers K, Abrell L, Alves E, Yanez Serrano A, Kesselmeier J., Karl T, Guenther A, Vickers C, Chambers J (2013) Emissions of putative isoprene oxidation products from mango under abiotic stress. *Journal of Experimental Botany*, 64: 3669-3679.
<http://dx.doi.org/10.1093/jxb/ert202>
11. **Jardine K**, Norman J, Abrell L, Monson R, Barron-Gafford G, Meyers K, Pavao-Zuckerman M, Dontsova K, Kleist E, Werner C, and Huxman T (2012) Green leaf volatiles and oxygenated metabolite emission bursts from mesquite branches following light-dark transitions. *Photosynthesis Research*, 113:321-333.
<http://dx.doi.org/10.1007/s11120-012-9746-5>
12. **Jardine K**, Abrell L, Jardine A, Saleska S, Arneth A, Monson R, Karl T, Goldstein A, Fares S, Loreto F, & Huxman T (2012) Within-plant isoprene oxidation confirmed by direct emissions of oxidation products methyl vinyl ketone and methacrolein. *Global Change Biology* 18(3):973-984.
<http://dx.doi.org/10.1111/j.1365-2486.2011.02610.x>
13. **Jardine K**, Abrell L, Yanez Serrano, A, Arneth A, Alves E, Kesselmeier J., Huxman T., Saleska S., Jardine A., Taylor T., and Artaxo P (2011) Ecosystem-scale compensation points of formic and acetic acid in the central Amazon. *Biogeosciences* 8: 3709-3720.
<http://www.biogeosciences.net/8/3709/2011/bg-8-3709-2011.pdf>
14. **Jardine, K.**, Abrell, L., Yanez Serrano, A. M., Arneth, A., Yoko Ishida, F., Huxman, T., Saleska, S., Jardine, A., Karl, T., and Artaxo, P. (2011) Within-Canopy Sesquiterpene Ozonolysis in Amazonia. *J. Geophys. Res.*, 116, D19301.
<http://dx.doi.org/10.1029/2011JD016243>
15. Karl T, Harley P, Emmons L, Thornton B, Guenther A, Basu C, Turnipseed A & **Jardine K** (2010) Efficient atmospheric cleansing of oxidized organic trace gases by vegetation. *Science* 330: 816-819.
<http://dx.doi.org/10.1126/science.1192534>
16. **Jardine K**, Sommer E, Saleska S, Huxman T, Harley P & Abrell L (2010) Gas-phase measurements of pyruvic acid and its volatile metabolites. *Environmental Science & Technology* 44: 2454-2460.
<http://dx.doi.org/10.1021/es903544p>

17. **Jardine K**, Abrell L, Kurc SA, Huxman T, Ortega J & Guenther A (2010) Volatile organic compound emissions from *Larrea tridentata* (creosotebush). *Atmospheric Chemistry and Physics* 10: 12191-12206. <http://www.atmos-chem-phys.net/10/12191/2010/acp-10-12191-2010.pdf>
18. **Jardine K**, Karl T, Lerdau M, Harley P, Guenther A & Mak JE (2009) Carbon isotope analysis of acetaldehyde emitted from leaves following mechanical stress and anoxia. *Plant Biology* 11: 591-597. <http://onlinelibrary.wiley.com/doi/10.1111/j.1438-8677.2008.00155.x/abstract>
19. **Jardine K**, Henderson W, Huxman T & Abrell L (2010) Dynamic Solution Injection: a new method for preparing pptv & ppbv standard atmospheres of volatile organic compounds. *Atmospheric Measurement Techniques* 3: 1569-1576. <http://www.atmos-meas-tech.net/3/1569/2010/amt-3-1569-2010.pdf>
20. **Jardine K**, Harley P, Karl T, Guenther A, Lerdau M & Mak JE (2008) Plant physiological and environmental controls over the exchange of acetaldehyde between forest canopies and the atmosphere. *Biogeosciences* 5: 1559-1572. <http://www.biogeosciences.net/5/1559/2008/bg-5-1559-2008.pdf>
21. Karl T, Guenther A, Turnipseed A, Patton EG & **Jardine K** (2008) Chemical sensing of plant stress at the ecosystem scale. *Biogeosciences* 5: 1287-1294. <http://www.biogeosciences.net/5/1287/2008/bg-5-1287-2008.pdf>
22. Karl T, Harley P, Guenther A, Rasmussen R, Baker B, **Jardine K** & Nemitz E (2005) The bi-directional exchange of oxygenated VOCs between a loblolly pine (*Pinus taeda*) plantation and the atmosphere. *Atmospheric Chemistry and Physics* 5: 3015-3031. <http://hal.archives-ouvertes.fr/docs/00/29/57/81/PDF/acp-5-3015-2005.pdf>

Book chapters

Biogenic volatile organic compounds in Amazonian forest ecosystems, **Jardine K** and Jardine A, Chapter 4, *The Large-scale Biosphere-Atmosphere Programme in Amazonia* (Springer, Ecological Studies).
Editors: L. Nagy, B. Forsberg, P. Artaxo (in press)

Other publications

Invention of dynamic ¹³C-pulse tracing (patent pending): <http://www.lbl.gov/TT/techs/lbnl2013-110.html>
LBNL personal page: <http://esd.lbl.gov/about/staff/kolbyjardine/>
Amazon VOCs wiki page: <https://voc-amazon.wikispaces.com/home>
Jardine K & Jardine A (2010) In Person: How Our Adventures Led to Careers in Science. *Science Careers*. http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2010_09_03/caredit.a1000086
Arizona Public Media interview: <https://www.azpm.org/s/3681-biosphere-2-air-quality-research/>
Kolby and Angie's Environmental Science and Adventure Page: <http://kolbala.livejournal.com/>

Work Experience/Collaborations/Field Experiments

Project Scientist, US Department of Energy, Lawrence Berkeley National Laboratory and National Institute for Amazon Research, June 2012-present: Establishment of a new analytical atmospheric plant biochemistry lab consisting of PTR-MS, TD100 thermal desorption-GC-MS, and cavity ringdown carbon isotope spectrometry. Tested instrumentation in California before deploying to the central Amazon for leaf to ecosystem level carbon metabolism studies using stable carbon isotope techniques and leaf photosynthesis systems. Current activities also include ecosystem level mapping of volatile metabolite emissions in the central Amazon through high vertical resolved ambient concentrations within and above the forest canopy as a part of GoAmazon 2014/15.

Visiting Scientist, University of Bielefeld, Germany, April 2012-June 2012: Development of a unified theory of plant primary and secondary metabolism. Experiments include stable carbon isotope leaf feeding

experiments (H^{13}CO_3 , pyruvate-2- ^{13}C , and glucose-2- ^{13}C) followed by stable carbon isotope analysis of CO_2 and volatile organic compound emissions.

BrazilianAir 2010, June 2010-July 2011: Head PI of 6-month remote field campaign in the central Amazon Basin. Vertical concentration gradients and branch/soil enclosure flux measurements of volatile organic compounds and ozone at the K34 tower at ZF2, Manaus, Brazil. Analytical techniques include PTR-MS, GC-PTR-MS, and GC-FID.

CREosote ATmosphere Interactions through Volatile Exchange (CREATIVE 2009), summer 2009: Head PI of 5 month remote off the grid field site with a mobile laboratory (PTR-MS and a GC-MS) in the Santa Rita Experimental Range. Goal to investigate the emissions of volatile organic compounds from creosotebush during the summer monsoon season. Branch and ecosystem scale fluxes were measured using enclosures, eddy covariance, and relaxed eddy accumulation techniques.

Biosphere 2, 2008-2012: Designed and installed the Ecosystem Metabolomics Laboratory (EML) in the Biosphere 2 complex and integrated it via heated tubing to the tropical rainforest and desert biomes.

Instruments installed

- A high sensitivity proton transfer reaction mass spectrometer (PTR-MS), Thermal desorption-gas chromatograph-mass spectrometer (TD-GC-MS).
- VOC calibration systems based on the permeation tube and dynamic solution injection techniques.
- A Licor 7000 and a Licor 840 $\text{CO}_2/\text{H}_2\text{O}$ analyzer.
- Programmable custom light and temperature controlled glass leaf chamber.
- CO_2 and water vapor concentration and isotope calibration equipment.
- A Picarro isotopic H_2O cavity ringdown spectrometer.
- An Aerodyne quantum cascade laser CO_2 isotopic analyzer.

National Center for Atmospheric Research, Boulder, CO, spring 2007: Identify the biochemical pathways that lead to the production and consumption of acetaldehyde in plants and its relationship between photosynthesis and respiration. Determine the plant physiological and environmental controls over the exchange of acetaldehyde between plants and the atmosphere. Development of a canopy scale compensation point model for acetaldehyde.

Canopy Horizontal Array Turbulence Study (CHATS) field experiment, Dixon, CA, summer 2007: Characterize the turbulent structure of the fields of aerosols and trace chemical species within and above the orchard canopy. Measurements included aerosol vertical concentration and flux measurements including species such as volatile organic compounds, ozone, NO_x , NO_y , H_2O , CO_2 , etc.

Intercontinental Chemical Transport Experiment (INTEX-B), Seattle, WA, spring 2006: NASA/NCAR aircraft study designed to better understand the transport and transformation of gases and aerosols on transcontinental/intercontinental scales. Primary responsibilities were the operation of a PTR-MS instrument for fast VOC concentration measurements aboard the NCAR C-130 research airplane.

Stony Brook University, Stony Brook, NY, Fall 2005 – May 2008, Design, fabrication, and control of instrumentation for gas chromatography-combustion-isotope ratio mass spectrometry. Branch enclosure measurements of carbon isotope ratio signatures of oxygenated volatile organic compounds from various biological sources. Investigation into biochemical pathways and plant physiological controls over OVOC exchange.

University of Michigan Biological Station, Pellston, MI, summer 2005 and 2006, Part of NSF Biosphere Atmosphere Research and Training Fellowship. Participated in climate change, plant ecology, atmospheric chemistry, and science and society workshops. Conducted flux measurements of oxygenated volatile organic compounds from soils and litter by GC-FID. Testing of an experimental dehydration membrane for removing water vapor from VOCs in air samples.

National Center for Atmospheric Research (NCAR), Boulder, CO, summer 2004, Visiting scientist. Design and fabrication of a cryogenic automated thermal desorption system for the analysis of volatile organic compounds by GC-MS.

Black Hills Ameriflux tower, South Dakota and Duke University Experimental Forrest (CELTIC study), summer 2003: Above canopy disjunct eddy covariance flux measurements of biogenic VOCs and vertically resolved flux estimates from inverse Lagrangian modeling. Comparison of VOC flux measurements between two Ionicon PTR-MS instruments and a Fast Isoprene Sensor. Gas Chromatography/Proton Transfer Reaction Mass Spectrometry to verify identity of molecules.

Arizona State University, Tempe, AZ, Fall 1999 – Fall 2000: Utilization of artificial photosynthetic reaction centers inserted in liposome membranes to pump protons in a light dependent manner into the interior of the vesicles creating a proton motive force. This was then used by the enzyme CFoF1 ATPsynthase to synthesize ATP from ADP and Pi. The ATP was then used to power the fixation of carbon dioxide.

University of Washington, Center for Nanotechnology, Seattle Washington, summer 2001: Project to develop light powered nanotrains for nanoscale transport of material by integrating biological and biomimetic components. Techniques included protein purification, surface nanopatterning with Teflon, liposome reconstitution of biological and biomimetic components, assembly of microscope flow cells, flowing in individual components and generating fluorescence microscopy movies.

New York University, NY, NY, Spring 1998 – Spring 1999: DNA nanotechnology experiments with Ned Seeman in the Chemistry Department at NYU. Techniques included DNA sequence design and self-assembly engineering, molecular modeling, operation of automated DNA synthesizers, gel electrophoresis, DNA sequencing, and atomic force microscopy to visualize the products of self-assembly.

Harvard University, Cambridge MA, summer 1997: Summer research internship in the Department of Organismic and Evolutionary Biology. Using forward genetics techniques we investigated the ability of the transposase gene product to excise the transposable element mariner from a target sequence. Techniques involved fly mutagenesis, mutant collection, element amplification by PCR, bacterial transformation, gel electrophoresis, and DNA sequencing.

Colorado School of Mines, Golden CO, Spring 1997: Worked with Dr. Kevin Mandernack on microbial influences of biogeochemical cycles.